

Yoga as Therapy for Neurodegenerative Disorders: A Case Report of Therapeutic Yoga for Adrenomyeloneuropathy

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Abstract

Yoga is a promising therapeutic modality for neurodegenerative diseases. This case study presents a therapeutic yoga protocol for adrenomyeloneuropathy (AMN) and its effect on a patient's quality of life (QOL), agility, balance, and peripheral dexterity. A 61-y-old man diagnosed with AMN who was experiencing (1) peripheral neuropathy in his legs and feet, (2) lower-back pain (LBP), and (3) osteoarthritis received 60-min weekly therapeutic yoga sessions for a 10-mo period. Yoga therapy included hatha yoga asanas (poses) and *pranayama* (breathing exercises). Hatha yoga asanas were aligned with 7 Berg Balance Scale (BBS) indicators to measure improvement in balance and range of motion. The 10-mo course of therapeutic yoga resulted in improved LBP; improved flexion of the patient's hips,

knees, and ankles; improved propulsion phase of walking; and improvement in the patient's ability to stand and balance without an assistive device. The effect of yoga therapy on the patient in this case study aligns with current QOL improvements noted in current research on yoga therapy for neurological disorders. The described concepts and methods of employing therapeutic yoga provide insights for clinicians into a modality that is low risk and low cost and that can support individuals with other neurological disorders, such as multiple sclerosis (MS), fibromyalgia (FM), and diseases of the peripheral nervous system. Further study is warranted to help determine the safety and efficacy of yoga therapy for these conditions.

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The practice of yoga as self-care for improved quality of life (QOL) is gaining popularity. The therapeutic use of yoga as a complementary health modality for neurological disorders, such as multiple sclerosis (MS), fibromyalgia (FM), and diseases of the peripheral nervous system is the subject of multiple research studies and clinical trials.¹ A meta-analysis of yoga therapy for musculoskeletal conditions—including FM, osteoarthritis (OA), and rheumatoid

arthritis (RA)—noted significant improvements in functional outcomes, particularly reduced pain and increased agility.²

Although current research supports yoga as one of several complementary and alternative medicine (CAM) modalities that are indicated for neurological disorders,³ each modality is unique in its approach and potential benefits. It is outside the scope of this article to discuss all CAM modalities and their effect on neurological disorders; however, this case report offers a discussion about the ways that yoga can affect QOL for people living with neurodegenerative conditions.

Various styles of yoga exist, some of which may not prove beneficial for certain medical conditions. Yoga practices that emphasize continuous and rigorous movement (*vinyasana*, or “flow”), practicing in extreme heat (*bikram*, or “hot” yoga), or repetitious intense breathing (*kundalini*, or “breath-of-fire” practice) may be contraindicated for clients or patients with neurological health challenges.⁴ Gentle or therapeutic yoga styles, with appropriate modifications individualized for a client or patient's abilities, are more suited.⁴

The practice of yoga therapy requires extensive training beyond the recommendations for training to teach general yoga classes. In 1999, the Yoga Alliance (YA), an organization dedicated to yoga outreach and education in the United States, established recommended standards for yoga teachers and yoga teacher-training programs.⁵ The YA accepts yoga teachers as registered members with a minimum of 200 teacher training hours (RYT200). Registered members may also gain an experienced teaching status when 1000 or more teaching hours have been recorded (eg, E-RYT200) and when additional teacher training hours have been completed (eg, RYT500).⁶

In 2012, the International Association of Yoga Therapists (IAYT) implemented educational standards for training yoga therapists.⁷ IAYT educational standards include 5 core areas of competency: (1) yoga foundations, (2) biomedical and psychological foundations, (3) teaching and therapeutic skills, (4) yoga therapy tools and their applications, and (5) professional practice.⁷ Each of the competencies has additional categories of educational requirements that include knowledge of human anatomy and physiology; biomechanics and movement; pathophysiology; contraindications of yoga practices for specific conditions and circumstances; common medical terminology; referencing current health care information; and ethics in practice, as well as in-depth knowledge of the range of yoga practices and their potential therapeutic effect for common conditions.⁷

IAYT defines *yoga therapy* as “the process of empowering individuals to progress toward improved health and well-being through the application of the teachings and practices of yoga.”⁷ The organization further explains that “the goals of yoga therapy include eliminating, reducing, or managing symptoms that cause suffering; improving function; helping to prevent the occurrence or re-occurrence of underlying causes of illness; and moving toward improved health and well-being. Yoga therapy also helps clients or students change their relationship to and identification with their conditions.”⁷

The current case report is an example of the use of yoga as therapy for a rare neurological disorder, adrenomyeloneuropathy (AMN). Adrenoleukodystrophy (ALD) is a genetic degenerative disease that affects the central nervous system. ALD consists of a spectrum of phenotypes, including AMN, which vary in the age of clinical presentation and the severity of the disease.⁸ These conditions are known as the ALD/AMN complex. This hereditary disease affects both males and females.⁸

AMN causes demyelization of nerve cells, particularly along the spinal column. A person with AMN may experience gradual sensory loss in his/her lower extremities, causing stiffness, weakness, or paralysis in the lower limbs; and ataxia, a lack of voluntary coordination of movement that affects the ability to walk. Other symptoms include adrenal insufficiency (Addison's disease); visual impairment; mild peripheral neuropathy; difficulty speaking; and other

physiological and behavioral changes.⁹ Although the authors were unable to find any published reports on yoga therapy and AMN, the symptoms of AMN are similar to other neurological disorders such as MS, FM, and diseases of the peripheral nervous system for which greater evidence exists for yoga's potential therapeutic effects.¹

Case Report

Zach is a 61-year-old male with AMN. Zach's AMN symptoms had been slowly progressing for 40 years, and he was formally diagnosed with AMN at age 35. Zach had experienced sensory losses in his legs and feet; lower-back pain (LBP); OA in his hips, knees, and ankles; and deafness in his right ear. He had also been diagnosed with scoliosis and bipolar disorder. His current daily pharmaceutical regimen included hydrocortisone and prednisone steroids; antispasmodic baclofen, administered via intrathecal pump by barbotage; lovastatin for high cholesterol; the antidepressants bupropion and venlafaxine; and over-the-counter glucosamine/chondroitin.

In the 10 years prior to Zach's introduction to yoga therapy, additional treatment strategies had included (1) 2 trials of an experiential drug protocol for Lorenzo's Oil, a 4:1 mix of oleic acid and erucic acid¹⁰; (2) 2 courses of physical therapy for 8 weeks; and (3) periodic acupuncture treatment.

Despite the challenges of AMN, Zach maintained an active lifestyle. He walked with his dogs using a sled-type walker in which he sat as the dogs, on leashes, pulled him. Sitting on a set of skis, Zach also participated in skiing, tethered to another skier who guided him down the slopes. He and his wife Emma enjoyed traveling around the country and the world.

Zach and his wife Emma were first introduced to yoga by attending a local yoga class. Emma's devotion to Zach was displayed by her constant encouragement during the class. The instructor, one of the authors, noted that this particular class was too challenging for Zach's ability to participate. After class, recommendations were made to Zach about using a chair or other props to better facilitate his participation in yoga. At Emma's request, private yoga sessions were established for Zach.

Initial Observations

Zach's private sessions began in February 2013. From February to December 2013, approximately 44 weeks, 60-minute yoga sessions occurred once weekly. As usual, private yoga therapy began with a review of Zach's medical history. Health challenges and lifestyle goals were determined through verbal discussion with Zach and observation of his movements. As is standard practice, this information was later integrated into a working assessment of Zach's condition, limitations, and possibilities for improvement.⁷

During an initial yoga session, observation helped the yoga therapist gain a sense of how Zach moved and

breathed. Observing how he stood and walked and how he used his arms and legs while conversing with the yoga therapist, as well as his facial expressions, influenced the therapist's tailoring of the instruction of the asanas (poses).

The therapist observed Zach's use of his rolling walker to move throughout his home. Zach pushed the walker, sliding his feet along the floor. His feet also crossed the midline (crossing over one another) rather than moving forward and parallel to each other. Zach's feet were cut, scraped, and bruised from sliding against the floor.

Yoga practice commenced with seated pranayama (ie, yoga breathing practices). Three-part breath—*dirgha pranayama*—is often the first breathing technique taught to new yoga practitioners. The 3 parts are the abdomen, diaphragm, and chest. During 3-part breath, the practitioner first completely fills his/her lungs with air, feeling the expansion of the belly, ribcage, and upper chest. He/she then exhales completely, reversing the flow.

Zach's breathing was stuttered as he attempted *dirgha pranayama*. His inhalation initially stopped at the middle lung chamber, around his heart's center, yet he was able to push past that location and breathe into the upper chamber of his lungs, as observed when his clavicle lifted. The exhale of breath appeared to be smooth.

Because of the sensory loss in his legs, Zach relied on the lumbar region of his back, his shoulders, and his arms to move around. As a result of his overuse and misalignment of these muscles, he experienced LBP. His hamstrings were tight, and his quadriceps were weak. The tightness of his hamstrings and hips made it difficult for Zach to sit up straight in a chair and particularly difficult to sit on the floor; therefore, a bolster was used to support his back. When sitting and standing, Zach's right shoulder and hip were both higher than his left shoulder and hip. Standing revealed Zach's scoliosis, which affected his hips, legs, and back. His sensory loss was predominantly on the left side. To maintain his balance, Zach hyperextended his left leg by pushing his knee posteriorly. He was concerned that his knee would buckle or spasm, causing him to fall. After the initial

session, suggestions were provided on how to proceed with an individualized yoga practice.

Therapeutic Intervention

Zach identified the following goals for his yoga practice: (1) improvement in posture, (2) improvement in balance and walking ability, and (3) lessening of his LBP.

Practicing mindful movement can be fostered by poses that require multisensory integration—visual, vestibular, and proprioceptive—to support proper physical alignment of the body. Specifically, yoga poses providing such integration are those that (1) focus on alignment of the feet, hips, and spine; (2) tone and stretch the hamstrings; (3) strengthen the quadriceps muscles; (4) bring more flexibility to the spine; (5) establish and maintain balance; and (6) strengthen concentration skills. Such a yoga protocol must focus on poses that align with 3 of the 8 limbs of yoga: (1) *asana*—physical practice, (2) *pranayama*—breath control, and (3) *dharana* (concentration).¹¹ These 3 limbs of yoga provide a foundational structure for the yoga protocol. The asanas selected were practiced through physical movement, supported by directed inhalation and exhalation, and through concentration on a specific body alignment before execution of the pose.

To measure Zach's progress in a thoughtful and scientific way, a standard measurement for human functionality was used, the Berg Balance Scale (BBS).¹² Using a research-based measurement tool provided a method for evaluating Zach's progress and assisted in the selection of asanas that were best suited to support his goals: (1) improving posture, balance, and walking; and (2) lessening LBP.

The BBS provides definitions of physical activities or actions that determine progress in sensory motor functions. By using several of the scale's indicators, a client's progress can be observed easily because the asanas require physical movements or actions similar with what the BBS indicators entail. Seven BBS indicators were aligned with a range of asanas and subsequently improved Zach's ability to perform the tasks (Table 1).

Table 1. Alignment of Hatha Yoga Asanas With 7 BBS Indicators

BBS Indicator	Yoga Asana (Pose)
1. Moving from sitting to standing	Seated <i>tadasana</i> (mountain pose) to standing <i>tadasana</i>
2. Standing unsupported for ≥2 min	<i>Surya namaskara</i> (sun salutation) with chair
3. Standing unsupported with eyes closed	<i>Urdhva hastasana</i> (upward salute)
4. Reaching forward with outstretched arms while standing	<i>Utkatasana</i> (chair pose)
5. Turning to look over left and right shoulder while standing	<i>Virabhadrasana II</i> (warrior II pose)
6. Standing unsupported, 1 foot in front	<i>Virabhadrasana I</i> (warrior I pose)
7. Standing on 1 leg	<i>Vrksasana</i> (tree pose)

Abbreviations: BBS = Berg Balance Scale.

Zach’s individualized yoga protocol varied with each weekly practice and progressed in difficulty over time. Some asanas were practiced while sitting in a chair or while standing against the wall or freely in the middle of the floor, with his walker or a chair nearby when a balance check was indicated. Zach was also able to practice certain asanas while lying or kneeling on the floor. For example, *tadasana* (mountain pose) was practiced while sitting, standing, and lying on the floor to support Zach’s conceptual understanding of alignment. In reclining mountain pose, placing a block between his feet helped to strengthen the muscles of the legs and support the parallel position of his feet. In addition to yoga mats, props included blocks, straps, blankets, pillows and bolsters, all items from Zach’s home.

The allocation of time for each portion of Zach’s sessions changed as his ability to stand without assistance and his balance improved. For example, during the first 3 months of practice, 10 minutes of class time were dedicated to standing poses and 3 minutes to balancing poses. For the next 3 months, more standing poses were added, resulting in up to 15 minutes of standing poses and up to 5 minutes of balancing poses. At 10 months, Zach practiced the standing and balancing portion of the class for 25 minutes.

Table 2 shows further details of Zach’s basic yoga practice.

Table 2. Basic Yoga Practice

WARM-UP POSES: Designed to release muscle tension and stiffness and prepare the body for movement.			
SAMPLE CHAIR WARM-UPS	INSTRUCTIONS	SAMPLE RECLINING WARM-UPS	INSTRUCTIONS
Seated <i>tadasana</i> (mountain pose); centering and pranayama practice	This portion of the practice was used to set a <i>dharana</i> (concentration) for the asana physical practice and to begin mindful movement with the pranayama. Pranayama practice: 4-4-4 breath; inhale to the count of 4, hold the breath for 4 counts, and exhale to the count of 4.	Reclining <i>tadasana</i> ; centering and pranayama practice	Use a blanket folded under the head and a block wedged between the feet to support alignment.
Seated side stretch	With the left hand holding onto the seat of a chair, inhale and extend the right arm upward and bend toward the left on exhale. Repeat on the other side.	Thread the needle—table pose with twist, shoulder to the floor	Use a bolster under each shoulder and head for support during the twist.
Twists	Sitting on right side of a chair with the feet parallel and flat on the floor, inhale with both arms moving upward, twist left toward the back of the chair, placing each hand on the back. Take 4 full breaths (inhale/exhale). Repeat on other side.	<i>Bidalasana</i> (cat/cow Pose)	Use a pillow or rolled blanket to provide support for the ankle and to reduce foot spasms.
Foot warm-ups	Walk in place. Keeping the ball of the foot on the floor, lift the right heel. Then lift the leg, keeping the knee bent and flexing the foot. Place the ball of the foot on the floor, then the heel. Alternate with the left foot. Practice with inhalation and exhalations. Repeat on other side. Repeat the instructions above. After lifting the foot off the floor, extend the leg. Bend the knee back and place the foot back on the floor, ball to heel. Repeat on the other side.	Reclined <i>supta padan-gusthasana</i> (big-toe pose)	Lift legs with a strap.

Table 2. (continued)

STRETCHES: Designed to lengthen and tone the muscles of the lower body.			
SAMPLE STRETCHES	INSTRUCTIONS	SAMPLE RECLINING STRETCHES	INSTRUCTIONS
Seated hamstring stretches with strap	Extend the legs in parallel, with heels on the floor (or a block), and the toes lifted. Place a strap around the ball of the feet. Exhale and fold forward, lengthening the spine over the legs.	Quadriceps stretch	Lying on the back with knees bent and feet flat on the floor, place a block between the shins. Engage legs by squeezing the block. Inhaling, lift both knees toward the chest. Exhaling, place the feet back on the floor.
Seated <i>Eka pada rajakapotasana</i> (pigeon pose)	Cross the right ankle over the left knee. Hold the right foot with the left hand and place the right hand on the right knee. On the inhale, lengthen the spine; on the exhale, bend forward over the right leg. Repeat on the other side.	Reclined <i>eka pada rajakapotasana</i>	Cross the right ankle over the left knee. Hold the right foot with the left hand and place the right hand on the right knee. Inhale. On the exhale, gently press the right knee forward. Repeat on the other side.

STANDING POSES: Designed to support alignment, strengthen muscles, and increase flexibility.	
SAMPLE STANDING POSES	INSTRUCTIONS
Tadasana	Place a block on the floor between the feet as a spacer.
Urdhva hastasana and pranayama	With a block on the floor between the feet, inhale as arms stretch overhead. Exhale as arms return back down toward the side.
Surya mamaskara	Use a chair for lunges and <i>adho mukha svanasana</i> (downward facing dog pose).
Trikonasana (triangle pose)	Employing a wide stance, use a chair on either side for support.
Virabhadrasana II (warrior II pose)	Employing a wide stance, using a chair on either side for support.
Virabhadrasana I (warrior I pose)	Face a wall. Place the hands on the wall, with arms straight and feet parallel. Step directly back with the right foot and bend the left knee. Repeat on other side.

BALANCING POSES: Designed to strengthen muscles and increase balance.	
SAMPLE BALANCING POSES	INSTRUCTIONS
Vrksasana (tree pose)	First practice against the wall; then stand away from the wall. with a chair. Shift the weight to the right leg and bend the left knee, placing the heel of the left foot against the standing right leg, with the ball of the foot pressing against the floor. Repeat on the other side.
Tadasana on tip of toe	Place the hands on a chair or wall.
Virabhadrasana III (warrior III)	Place the hands on a chair or wall.

COOL DOWN POSES: Designed to relax muscle tension in preparation for relaxation.	
SAMPLE COOL DOWN POSES	INSTRUCTIONS
Reclined mountain pose (supta tadasana)	With a block between the feet, place the inner side of each foot against the longest edge of the block.
Setu bandha sarvangasana (supported bridge pose)	If no LBP is present, place a block at its lowest level underneath the sacrum area. If LBP is present, place 2 folded blankets underneath the sacrum area to create a gentle lift.
Reclining twists	Lying in tadasana, bend the right knee and place the foot flat on the floor. Place the left hand on the right knee and gently ease the knee toward the left, extending the left arm at shoulder height along the floor. Repeat on the other side.

Table 2. (continued)

RELAXATION PRACTICE, SAVASANA: Designed at the end of each session to provide a 10-min restorative pose and guided relaxation. The following is a list of restorative poses typically used. Details and instructions can be found in the following text: <i>Relax & Renew: Restful Yoga for Stressful Times</i> by Judith Lasater. ¹³	
SAMPLE RELAXATION POSES	INSTRUCTIONS
Supported bound-angle pose	The bolsters are beneficial in supporting the body while following the instructions for the guided relaxation.
Elevated legs-in-a-chair pose	With sensory loss in lower limbs, legs-up-the-wall pose may prove challenging. Placing the legs in a chair provides more support and makes relaxation more obtainable.
Supported bridge pose	This pose is more challenge for relaxing; however, it encourages lengthening of the thoracic spine and opening the front ribcage.
Basic relaxation pose/savasana with props	Place 2 folded blankets on top of the mat and a rolled blanket under the knees for additional support. The pose is ideal for relieving LBP.

Abbreviations: LBP = lower-back pain.

Results

After 10 months of practice, Zach experienced many improvements in QOL. The authors saw improvement in Zach’s ability to perform the asanas aligned with the 7 indicators of the BBS. Improved flexion of his hips, knees, and ankles allowed Zach to move from sitting to standing and improved the propulsion phase of his walking. Zach was able to walk for short periods without his walker, demonstrated as he walked back and forth along a 15-meter hallway in his home.

Zach was able to align his feet in parallel form as he had become more mindful of the inner rotation of his hips and to adduct his legs toward the midline. Prior to practicing the mountain pose, Zach’s tendency was to stand with his feet turned out in opposite directions as a result of rotating his hips and legs. Practicing *tadasana* (mountain pose), *utkatasana* (chair pose), and *vrksasana* (tree pose) weekly helped to improve his dorsiflexion and plantar flexion and increased his ability to distinguish between lifting his entire foot off the floor from lifting solely his heels or toes.

The weekly practice of the 5 poses in a modified vinyasana improved the extension and flexion of Zach’s hips, spine, arms, and legs. Vinyasana is a fluid moving sequence of poses. *Surya namaskara* (sun salutation) was practiced for approximately 5 minutes of class time and called for Zach to stand unsupported with his eyes closed as he began by focusing his concentration on the movement of his body, together with his breathing.

Although his scoliosis remained, Zach progressed in his ability to balance while standing and rotating his spine through flexion and extension. Zach was able to perform standing poses, such as *utthita trikonasana* (triangle), and *virabhadrasana* I and II (warrior I and II), holding each pose for at least 1 minute.

Each week, Zach was asked to report on his LBP, which improved after 7 months. For the last 3 months of the training, Zach reported no significant LBP and was able to perform supported *setu bandha sarvangasana*

(bridge pose) with a block between his sacrum and the floor as well as full bridge pose without the use of props.

During later practice sessions, Zach needed few reminders to focus his intention on his feet. His ability to focus mindfully had resulted in coordinated movement of his legs and feet that continued to have few or no sensory cues.

Zach reported that his experience with yoga caused him to develop a greater awareness of his body’s alignment. He had found that his balance was better and his ability to walk had improved. Zach summed up his experience by saying, “Anything I can visualize, I can do!”

Next Steps

Future plans include encouraging Zach to establish a consistent home practice. He currently practices sporadically on his own. Adding 1 or 2 additional days of practice would help to maintain flexibility in his spine, hips, and knees while strengthening the legs and feet.

The authors intend to encourage Zach to attend an appropriate public yoga class that focuses on supporting people with neurological disorders. Classes may include a chair yoga class or therapeutic yoga class. This type of class would provide Zach with additional social support and the opportunity to inspire others.

Conclusion

The progression of Zach’s improvements in agility, balance, and walking, as well as his decreased LBP, was supported by his willingness and dedication to weekly yoga practice. Yoga therapy, like other CAM practices, requires a consistent commitment to promote steady progress. As a mind-body strategy for supporting health, yoga is a self-care modality. Individuals must commit to exploring a deeper understanding of self as an integral part of their improving QOL.

The strength of this case study was the consistency of yoga practice for an extended period of time, which

provided the yoga therapist with an opportunity to observe the client's progress on a weekly basis. However, this case study should not be generalized to other individuals, health conditions, or yoga protocols. Since the origination of the practitioner-client relationship was not intended for research purposes, the measurement of progress in this case study was limited to the yoga therapist's weekly anecdotal notes and conversations with the client that may appear subjective. However, the effect of yoga therapy on the client in this case study does align with current QOL improvements noted in current research on yoga therapy for neurological disorders¹⁴; therefore, further research is warranted.

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